Grade 9 Science
Program Outcomes
(Resource Development Draft)

November 1999

This draft incorporates minor revisions based on field review of the validation draft. Further minor adjustments to the program may be made following field testing in September – December 2000.

Unit Organization

In Grades 7–9, five units of study are outlined at each grade level. At grades 10–12, four units of study are outlined for each grade level. Each unit includes the following components.

Unit Overview

Each unit of study begins with an overview that introduces the contents of the unit and suggests an approach to its development.

Focussing Questions

These questions frame a context for introducing the unit and suggest a focus for investigative activities and application of ideas by students.

Key Concepts

Key concepts identify major ideas to be developed in each unit. Some of the key concepts may be addressed in additional units at the same grade/course level, as well as at other grade/course levels. The intended scope of treatment of these concepts is indicated by the learner outcomes.

Outcomes

Two levels of outcomes are provided in the draft program and courses of study:

- General Outcomes: These are the major outcomes for each unit. For STS and knowledge, the outcomes are combined and unique to each unit. For skills and attitudes, the outcomes are common to all units.
- Specific Outcomes: These are detailed outcomes that flesh out the scope of each unit. They are shown in bulleted form.

Examples

Many of the outcomes are supported by examples. The examples **do not form part of the required program** but are provided as an illustration of how the outcomes might be developed. Illustrative examples are written in *italics* and separated from the outcomes by being placed in parentheses.

Unit Emphases

Each unit of study in secondary science begins with an overview and a set of focussing questions that identify a context for study. In defining the context, one of the following areas of emphasis is identified for each unit.

- *Nature of Science* emphasis: In these units student attention is focused on the processes by which scientific knowledge is developed and tested, and on the nature of the scientific knowledge itself. Skills emphasized in these units are the skills of scientific inquiry.
- *Science and Technology* emphasis: In these units students seek solutions to practical problems by developing and testing prototypes, products and techniques to meet a given need. The skills emphasized are those of problem solving, in combination with the skills of scientific inquiry.
- *Social and Environmental Contexts* emphasis: In these units student attention is focused on issues and decisions relating to how science and technology are applied. Skill emphasis is on the use of research and inquiry skills to inform decisions; students seek and analyze information and consider a variety of perspectives.

Unit A: Biological Diversity *(Social and Environmental Contexts emphasis)*

Overview: Biological diversity is reflected in the range of species found in local and global environments, and by subtle variations in characteristics found within individual species. In this unit students learn that diversity is maintained through natural processes of sexual and asexual reproduction, though the survival of individual species—and variations within those species—may be influenced by ecological and human-caused factors. Students examine trends toward loss of diversity, and examine related issues concerning environmental quality and the impact of technologies.

This unit builds on ideas introduced in Grade 7, Unit A: *Interactions and Ecosystems*, and introduces ideas that will be developed further in Science 20, Unit B: *Changes in Living Systems.*

Focussing Questions: What is biological diversity, and by what processes do diverse living things pass their characteristics on to future generations? What impact does human activity have on biological diversity?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the learning outcomes below.

- ☆ biological diversity
- ☆ species and populations
- ☆ diversity within species
- ☆ habitat diversity
- ☆ niches
- ☆ asexual and sexual reproduction
- ☆ inheritance
- ☆ chromosomes, genes and DNA (introductory treatment only)
- ☆ cell division (includes binary fusion and formation of sex cells)
- ☆ natural and artificial selection of genetic characteristics

STS and Knowledge Outcomes

Students will:

1. Investigate and interpret diversity between species and within species, and describe how diversity contributes to species survival
   - observe variation in living things, and describe examples of variation between species and within species *(e.g., observe and describe characteristics that distinguish two closely related species)*
   - investigate adaptations of species to their environments, and infer the function of different structures *(e.g., interpret variation in animal structures for locomotion or for securing food)*
   - identify examples of niches, and describe the role of variation in enabling closely related living things to survive in the same ecosystem *(e.g., investigate different bird species found in a local park ecosystem, and infer how each is adapted to life within that ecosystem)*
   - investigate and interpret dependencies between species that link the survival of one species to the survival of others *(e.g., by providing habitat, food, means of fertilization, or a source of oxygen)*
   - identify the role of variation in species survival under changing environmental conditions *(e.g., resistance to disease; ability to survive in severe environments)*

2. Investigate the nature of reproductive processes and their role in transmitting species characteristics
   - distinguish between sexual and asexual reproduction, and identify and interpret examples of asexual and sexual reproduction in different species

  - describe representative types of asexual reproduction *(e.g., fission in the amoeba, budding in hydra, production of zoospores in some fungi)*
  - describe representative types of sexual reproduction *(e.g., conjugation in bacteria, cross-fertilization in seed plants, sexual reproduction in mammals)*
  - describe examples of organisms that show both sexual and asexual reproduction *(e.g., yeasts that reproduce both by budding and sexual reproduction; plants that reproduce through suckering, runners or bulbs, as well as by seed production)*
  - describe the formation of zygote and embryo in plant and animal reproduction
- describe examples of variation in characteristics within a species and identify examples of both discrete and continuous variation *(e.g, hand clasping preference is an example of a discrete variation; the length of human hands varies on a continuum)*
- investigate the transmission of characteristics from parents to offspring, and identify examples of characteristics in offspring that are:
  - the same as the characteristics of both parents
  - the same as the characteristics of one parent
  - intermediate between parent characteristics
  - different from both parents
- distinguish those characteristics that are heritable from those that are non-heritable and identify characteristics for which heredity and environment may both play a role *(e.g., recognize that eye colour is heritable, but that scars are not; recognize that a person's height and weight may be largely determined by heredity but that diet may also play a role)*
- identify examples of dominant and recessive characteristics *(e.g., dominance of brown eyes over blue eyes)* and recognize that dominance and recessiveness provide only a partial explanation for the variation of characteristics in offspring

3. Describe, in general terms, the role of genetic materials in the continuity and variation of species characteristics, and investigate and interpret related technologies
   - describe, in general terms, the relationship of chromosomes, genes and DNA and interpret their role as repositories of genetic information
   - distinguish between cell division by binary fission, and cell division in the formation of sex cells; and describe—in general terms—the syntheses of genetic materials that takes place during fertilization. *(Note: At this level, students should understand that formation of sex cells involves the halving of the cell's genetic materials, and that this process leads to zygote formation. Opportunity for further study of the specific mechanisms of cell division (mitosis and meiosis) will be provided in later courses.)*
   - compare sexual and asexual reproduction, in terms of the advantages and disadvantages *(e.g., recognize that asexual reproduction provides an efficient means of transmitting characteristics, and that sexual reproduction provides an opportunity for recombination of characteristics)*
   - distinguish between—and identify examples of—artificial and natural selection *(e.g.; evolution of beak shapes in birds; development of high milk production in dairy cows)*
   - describe, in simple terms, some of the newly emerging technologies for recombining genetic material and identify questions and issues related to their application

4. Identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making
   - describe the relative abundance of species on Earth and in different environments *(e.g., note the overall abundance of insect species; note that in harsh environments there are relatively fewer species found than in temperate and tropical environments)*

- describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes *(e.g., investigate the effect of changing river characteristics on the variety of species living in the river; investigate the effect of changing land use on the survival of wolf or grizzly bear populations)*
- evaluate the success and limitations of various local and global strategies for minimizing loss of species diversity *(e.g., breeding of endangered populations in zoos, development of seed banks; designating protected areas, development of international treaties regulating trade of protected species and animal parts)*
- investigate and describe the use of biotechnology in environmental, agricultural or forest management, and identify potential impacts and issues *(e.g., investigate issues related to development of patented crop varieties, and varieties that require extensive chemical treatments; identify issues related to selective breeding in game farming and in rearing of fish stocks)*

Skill Outcomes *(focus on applying science to inform decision-making processes)*

Initiating and Planning

Students will:

Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- identify science-related issues *(e.g., identify issues related to loss of species diversity)*
- identify questions to investigate arising from science-related issues *(e.g., "What factors affect the ability of organisms to survive and reproduce in this ecosystem?")*
- state a prediction and a hypothesis based on background information or an observed pattern of events *(e.g., predict changes to an area of local parkland that is subject to intense use; hypothesize means of impact, such as soil compaction and disturbance of nest sites)*
- define and delimit questions and problems to facilitate investigation *(e.g., delimit an electronic search for information on species survival by framing a question about a specific group of organisms or a specific ecosystem)*

Performing and Recording

Students will:

Conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data

- observe and record data, and prepare simple line drawings *(e.g., compare two related plants, by measuring, describing and drawing them)*
- estimate measurements *(e.g., estimate the population of given plant species within a study plot)*
- research information related to a given issue *(e.g., conduct an electronic search for information on factors that affect the reproduction and survival of wood frogs)*

Analyzing and Interpreting

Students will:

Analyze qualitative data, and develop and assess possible explanations

- identify strengths and weaknesses of different ways of displaying data *(e.g., compare different ways of recording and displaying data on plant variation in a study plot)*

- interpret patterns and trends in data, and infer and explain relationships among the variables *(e.g., interpret data on changing animal populations, and infer possible causes)*
- apply given criteria for evaluating evidence and sources of information *(e.g., evaluate sources based on their currency, credibility, and the extent to which claims are supported by data)*
- identify new questions and problems that arise from what was learned

Communication and Teamwork

Students will:

Work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results

- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., illustrate and compare methods of reproduction in sample organisms studied)*
- evaluate individual and group processes used in investigating an issue and evaluating alternative decisions *(e.g., evaluate strategies for locating information, such as the use of particular key words or search tools; evaluate approaches for sharing work on a given research task and for synthesizing the information found)*
- defend a given position on an issue, based on their findings *(e.g., defend a position on a proposed measure to protect a particular plant or animal population)*

Attitude Outcomes

Appreciation of Science

Students will be encouraged to:

- appreciate the role, contributions and limits of science and technology *(e.g., recognize that scientific research can lead to new questions and issues; recognize that science can help assess potential impacts of technologies but cannot determine future impacts with certainty)*
- appreciate the diversity of individuals and societal groups that have contributed to science and technology *(e.g., show awareness that scientific study of changing animal and plant populations can arise from a variety of global needs, involving many individuals and organizations)*

Interest in Science

Students will be encouraged to:

- show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., select and explore media on topics related to species diversity; express interest in hobbies and careers that involve the care, culture and study of living things)*

Scientific Inquiry

Students will be encouraged to:

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., strive to assess a problem accurately by careful analysis of evidence gathered; critically consider ideas and perceptions, recognizing that the obvious is not always right)*

Collaboration

Students will be encouraged to:

- work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., choose a variety of strategies, such as active listening, paraphrasing and questioning, in order to understand other points of view; accept various roles within a group, including that of leader)*

Stewardship

Students will be encouraged to:

- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., consider implications of changing land use on the welfare and survival of living things; identify potential conflicts in attempting to meet the wants and needs of humans and at the same time provide life-supporting environments for all living things)*
- demonstrate sensitivity in the approach used to conduct investigations of local environments *(e.g., minimize environmental impact during studies, by avoiding sampling that will affect an animal or plant population)*

Safety

Students will be encouraged to:

- show concern for safety in planning, carrying out and reviewing activities *(e.g., follow safety procedures in outdoor investigations)*

Unit B: Matter and Chemical Change *(Nature of Science emphasis)*

Overview: Different materials have different properties. The ability to distinguish between different substances and make sense of their properties, interactions and changes requires development of ideas about chemical substance.

In this unit, students are introduced to the formal study of chemical substance through laboratory investigations and introductory studies of chemical theory. In the laboratory, students observe and compare chemical substances and—with guidance on safety—investigate the properties of materials and the ways they interact. In conjunction with these studies, students are introduced to ideas about elements and compounds, and corresponding structural ideas of atoms and molecules. Theoretical ideas are introduced as means for explaining, interpreting and extending their laboratory findings; and include a general introduction to the periodic table, chemical nomenclature and simplified ways of representing chemical reactions.

This unit builds on ideas introduced in Grade 8, Unit B: *Mix and Flow of Matter*, and introduces ideas that will be developed further in Science 10, Unit A: *Energy and Matter in Chemical Change*.

Focussing Questions: What are the properties of materials, and what happens to them during chemical change? What evidence do we have of chemical change; and what ideas, theories or models help us explain that evidence?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the learning outcomes below.

- ☆ WHMIS and safety
- ☆ substances and properties
- ☆ endothermic and exothermic reactions
- ☆ reactants and products
- ☆ conservation of mass
- ☆ factors affecting reaction rates
- ☆ periodic table
- ☆ elements, compounds and atomic theory
- ☆ chemical nomenclature (introductory treatment)

STS and Knowledge Outcomes

Students will:

1. Investigate materials, and describe them in terms of their physical and chemical properties
   - illustrate and explain how our observations are guided by our initial ideas and by the tools and techniques that we use *(e.g., describe how ideas such as "solubility" and "conductivity" can be used to guide observations; describe how the tools or techniques of study can affect what we observe)*
   - investigate and describe properties of materials *(e.g., investigate and describe the melting point, solubility and conductivity of materials observed)*
   - describe and apply different ways of classifying materials based on their composition and properties
     - distinguish between pure substances, solutions and mixtures
     - distinguish between metals and nonmetals
     - identify and apply other methods of classification
   - identify conditions under which properties of a material are changed, and critically evaluate if a new substance has been produced

2. Describe and interpret patterns in chemical reactions
   - identify evidence for conservation of chemical substance *(e.g., identify and apply techniques for containing and comparing the quantity of reactants and products in a chemical reaction)*
   - describe examples of household reactions that involve chemical change
   - distinguish between materials that react readily and those that do not
   - identify and evaluate dangers of caustic materials and potentially explosive reactions
   - observe heat generated or absorbed in chemical reactions, and identify examples of endothermic and exothermic reactions
   - identify conditions that affect rates of reactions *(e.g., investigate and describe how factors, such as heat, concentration, surface area and electrical energy, can affect a chemical reaction)*
   - describe combustion, corrosion and other reactions involving oxygen, and identify the significance of these reactions for living things and inorganic processes *(e.g., describe impacts of corrosion and identify measures to prevent corrosion)*

3. Describe ideas used in interpreting the chemical nature of matter—both in the past and present—and identify example evidence that has contributed to the development of these ideas
   - distinguish between observation and theory, and provide examples of how models and theoretical ideas are used in predicting and explaining observations *(e.g., note that kinetic molecular theory is used to explain why materials contract when cooled, but that other theoretical ideas are needed to explain why water expands as it cools from 4° to 0° Celsius)*
   - describe early ideas about the nature of substances and chemical change *(e.g., describe early ideas about the nature of gases and their role in combustion and respiration)*
   - describe, illustrate and interpret early ideas about the nature of particles that underlie matter *(e.g., describe and compare Dalton's billiard ball model of the atom, and Rutherford's planetary model)*
   - demonstrate an understanding of the periodic table—focusing on the first 18 elements—and use the periodic table to identify the number of protons and electrons in each atom, and to describe, explain and predict observable properties of elements *(e.g., predict reactivity, conductivity and relative mass of different elements based on their position in the table)*
   - recognize the need to describe and explain different ways that atoms combine to form molecules, and the changes in properties that result

4. Apply simplified chemical nomenclature in describing elements, compounds and chemical reactions
   - identify/describe chemicals commonly found in the home, and write the chemical symbols *(e.g., salt [$NaCl$]; water [H_2O]; sodium hydroxide [$NaOH$] used in household cleaning supplies)*
   - interpret the combining ratios signified by chemical formulae, and identify examples of combining ratios found in some common materials *(Students should recognize that some materials have multiple combining ratios e.g., CO, CO_2, Fe_2O_3, Fe_3O_4)* **[Prerequisite Skill: Grade 8 Mathematics, Number Operations, SO 15]**
   - assemble or draw simple molecular models *(e.g., construct models of some carbon compounds using toothpicks, peas and cubes of potato)*
   - describe familiar chemical reactions, and represent these reactions using word equations and chemical formulas, and by constructing models of reactants and products *(e.g., describe combustion reactions such as: Carbon + Oxygen → Carbon dioxide [$C + O_2 \rightarrow CO_2$]; corrosion reactions such as: Iron + Oxygen → Iron Oxide [$Fe + O_2 \rightarrow Fe_3O_4$]; replacement reactions such as the following reaction which might be studied in connection with Unit D (Electrical Principles and Technologies): Zinc + Copper Sulfate → Zinc Sulfate + Copper [$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$])*

Note: balancing of equations is not required at this level. Teachers may want to inform students about opportunities for further study of chemistry in Science 10 and in Science 14–24.

Skill Outcomes *(focus on scientific inquiry)*

Initiating and Planning

Students will:

Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- identify questions to investigate *(e.g., after observing that materials react at different rates, ask questions about the reactivity of particular materials or about conditions that affect the rate of reaction)*
- define and delimit questions and problems to facilitate investigation *(e.g., reframe a general question, such as "What affects the speed of reactions?" to one or more specific questions, such as "How will temperature affect the rate of reaction between materials x and y?" or "How will moisture affect the rate of reaction between x and y?")*
- state a prediction and a hypothesis based on background information or an observed pattern of events
- select appropriate methods and tools for collecting data and information and for solving problems *(e.g., select appropriate print and electronic sources for information about chemical elements, and use appropriate research techniques to locate required information)*

Performing and Recording

Students will:

Conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data

- carry out procedures, controlling the major variables *(e.g., investigate the effect of particle size on a chemical reaction, taking care to identify and control other potentially relevant variables)*
- observe and record data, and prepare simple drawings *(e.g., represent a molecule studied through a drawing)*
- demonstrate a knowledge of WHMIS standards, by using proper techniques for handling and disposing of laboratory materials
- research information relevant to a given question *(e.g., research properties of materials)*

Analyzing and Interpreting

Students will:

Analyze qualitative data, and develop and assess possible explanations

- compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs and scatterplots *(e.g., present data on different chemical substances in a form that can be readily compared)* **[Related Skills: Grade 7 Mathematics, Statistics and Probability, SO 4; Grade 8 Mathematics, Statistics and Probability, SO 3; Grade 9 Mathematics, Statistics and Probability, SO 2, 3, 4]**
- calculate theoretical values of a variable *(e.g., predict the mass of the products of a chemical reaction, based on the mass of reactants to be used)*
- identify and suggest explanations for discrepancies in data

- state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea
- identify new questions and problems that arise from what was learned *(e.g., identify new questions, such as "Why do different compounds containing the same elements behave differently?" or "How do atoms stick together in a molecule?")*

Communication and Teamwork

Students will:

Work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., follow given safety procedures)*
- evaluate individual and group processes used in planning, problem solving, decision making and completing a task *(e.g., evaluate the relative success and scientific merits of different approaches to drawing and making models of atoms and molecules)*
- evaluate individual and group processes used in planning and carrying out investigative tasks

Attitude Outcomes

Appreciation of Science

Students will be encouraged to:

- appreciate the role, contributions and limits of science and technology *(e.g., appreciate that scientific ideas may change over time as more evidence is gathered; appreciate that scientific knowledge involves development of models, which—although useful—may not be verifiable)*
- appreciate the diversity of individuals and societal groups that have contributed to science and technology *(e.g., show an interest in the contributions women and men—from many cultural backgrounds and different times—have made to the development of modern science)*

Interest in Science

Students will be encouraged to:

- show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., express a degree of satisfaction at understanding science concepts that are challenging)*

Scientific Inquiry

Students will be encouraged to:

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., seek data that is accurate and based on appropriate methods of investigation; consider observations and ideas from a number of sources during investigations and before drawing conclusions; honestly report and record all observations, even when the evidence is unexpected)*

Collaboration

Students will be encouraged to:

- work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., demonstrate interest and become involved in decision making that requires full-group participation; assume responsibility for their share of the work to be done; willingly work with new individuals, regardless of their age, gender, or physical or cultural characteristics)*

Stewardship

Students will be encouraged to:

- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that the materials we develop may have environmental consequences when we dispose of them; participate in school projects that address STS issues)*

Safety

Students will be encouraged to:

- show concern for safety in planning, carrying out and reviewing activities *(e.g., read the labels of materials before using them, and ask for help if safety symbols are not clear or understood; carefully manipulate materials, using skills learned in class; willingly wear proper safety attire without having to be reminded; ensure the proper disposal of materials; readily alter a procedure to ensure the safety of members of the group; immediately advise the teacher of spills, breaks and unusual occurrences, and use appropriate techniques and materials to clean up)*

Unit C: Environmental Chemistry *(Social and Environmental Contexts emphasis)*

Overview: Environments are often viewed from a physical and biological perspective, but to fully understand how they function, it is important to view them from a chemical perspective as well. A study of environmental chemistry helps students become aware that chemical substances make up the underlying fabric of the world and are part of the process in all natural cycles and changes. Through this unit students also become aware of human-produced chemical substances that enter and interact with environments, and investigate potential impacts of different substances on the distribution and abundance of living things.

This unit builds on ideas introduced in Science 8 Unit A: *Cells and Systems*, Unit B: *Mix and Flow of Matter*, Unit E: *Fresh and Saltwater Systems,* and Science 9 Unit B: *Matter and Chemical Change.* The unit introduces ideas that will be developed further in Science 10 Unit C: *Flow of Matter in Living Systems* and in Science 20 Unit B: *Changes in Living Systems.*

Focussing Questions: What substances do we find in local and global environments? What role do they play, and how do changes in their concentration and distribution affect living things?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the learning outcomes below.

- ☆ chemicals essential to life
- ☆ substrates and nutrients
- ☆ air and water quality
- ☆ organic and inorganic material
- ☆ acids and bases
- ☆ ingestion and absorption of materials
- ☆ concentration and dispersal
- ☆ evidence of toxicity
- ☆ stability and biodegradability
- ☆ hazards, probabilities and risk assessment
- ☆ uncertainties in environmental monitoring and in assessing toxicity and risk

STS and Knowledge Outcomes

Students will:

1. Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
   - identify common organic and inorganic substances that are essential to the health and growth of humans and other living things and illustrate the roles served by these materials *(e.g., identify calcium as an essential material for bones; identify minerals that are known to enhance plant growth—but that limit growth if too little or too much is available)*
   - describe, in general terms, the forms of organic matter synthesized by plants and animals
   - describe and illustrate processes by which chemicals are introduced to the environment or their concentration is changed *(e.g., dilution in streams, biomagnification through food chains)*
   - describe the uptake of materials by living things through ingestion or absorption, and investigate and describe evidence that some materials are difficult for organisms to break down or eliminate *(e.g., DDT, mercury)*
   - identify questions that may need to be addressed in deciding what substances—in what amounts—can be safely released into the environment *(e.g., identify questions and considerations that may be important in determining how much phosphate should be released into river water)*

2. Identify processes for measuring the quantity of different substances in the environment, and for monitoring air and water quality
   - identify substrates and nutrient sources for living things within a variety of environments
   - describe and illustrate the use of biological monitoring as one method for determining environmental quality *(e.g., assess water quality, by observing the relative abundance of various vertebrate and invertebrate species)*
   - identify chemical factors in an environment that might affect the health and distribution of living things in that environment *(e.g., available oxygen, pH, dissolved nutrients in soil)*
   - apply and interpret measures of chemical concentration in parts per million, billion or trillion **[Prerequisite Skills: Grade 8 Mathematics, Number Operations, SO 14, 15]**
   - identify acids, bases and neutral substances based on measures of their pH *(e.g., use indicator solutions or pH meters to measure the pH of water samples)*
   - investigate safely and describe the effects of acids and bases on each other and on other substances *(e.g., investigate and describe the reaction that results when baking powder is dissolved; describe the role of acids and bases in neutralizing each other)*
   - describe effects of acids and bases on living things *(e.g., acid rain in lakes, antacids for upset stomachs; pH in shampoos and conditioners)*

3. Analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment
   - describe mechanisms for transfer of materials through air and water, and identify factors that may accelerate or retard their distribution *(e.g., wind speed, soil porosity)*
   - describe mechanisms for biodegradation, and interpret information on the biodegradability of different materials
   - comprehend and interpret information on the biological impacts of hazardous chemicals on local and global environments *(e.g., interpret evidence for environmental changes in the vicinity of a substance release; interpret LD50 data [LD50 refers to the amount of a substance found to be lethal to 50% of a population, if ingested]; identify concerns with disposal of domestic wastes such as paints and oils, and industrial wastes)*
   - describe and evaluate methods used to transport, store and dispose of hazardous household chemicals
   - investigate and evaluate potential risks resulting from consumer practices and industrial processes, and identify processes used in providing information and setting standards to manage these risks *(e.g., interpret and explain the significance of manufacturer's information on how wood preservatives can be safely applied; recognize that individuals may have greater sensitivity to particular chemical substances than do others in the general population)*
   - identify and evaluate information and evidence related to an issue in which environmental chemistry plays a major role *(e.g., evaluate evidence that the use of insecticides to control mosquitoes has an effect/has no effect on bird populations)*

Skill Outcomes *(focus on applying science to inform decision-making processes)*

Initiating and Planning

Students will:

Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- identify science-related issues *(e.g., identify issues regarding the use of soil fertilizers)*

- identify questions arising from practical problems and issues *(e.g., ask questions about the needs of different living things for nutrients and about the mechanisms by which these nutrients are obtained)*
- state a prediction and hypothesis about the concentration or dispersal of a chemical substance within an environment *(e.g., state a hypothesis that relates the amount of oxygen in a local water sample to the presence or absence of dissolved nutrients)*
- select appropriate methods and tools for collecting data and information and for solving problems *(e.g., design an investigation to compare the chemical characteristics of two soils)*

Performing and Recording

Students will:

Conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data

- identify data and information that are relevant to the issue
- select and integrate information that is relevant to the issue *(e.g., demonstrate proficiency in uploading and downloading text, image, audio and video files)*
- use instruments and materials effectively and accurately for collecting data *(e.g., measure and compare the pH in household products, foods and environments)*
- organize data, using a format that is appropriate to the task or experiment
- use tools and apparatus safely

Analyzing and Interpreting

Students will:

Analyze qualitative data, and develop and assess possible explanations

- identify strengths and weaknesses of different ways of displaying data
- identify and suggest explanations for discrepancies in data *(e.g., identify possible reasons for variation in the measured concentration of a chemical, where one sample is very different from others or where one group has a very different result from others)*
- identify the line of best fit on a scatterplot, and interpolate or extrapolate based on the line of best fit *(e.g., interpret class data on the effects of acidity on mould growth, graph the data, prepare a line of best fit, and predict the amount of growth that might be expected at different acidity values)* **[Related Skills: Grade 9 Mathematics, Statistics and Probability, SO 4, 5]**
- apply given criteria for evaluating evidence and sources of information *(e.g., use scatterplot data in evaluating how strong a relationship exists between two variables; evaluate claims of environmental impacts based on the scope and relevance of supporting evidence)* **[Related Skills: Grade 9 Mathematics, Statistics and Probability, SO 2, 3]**
- identify new questions and problems that arise from what was learned

Communication and Teamwork

Students will:

Work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results

- work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise
- receive, understand and act on the ideas of others *(e.g., seek and achieve group consensus on procedures to be used in an investigative activity, and act on that consensus)*

- defend a given position on an issue or problem, based on their findings *(e.g., provide a clear rationale for a choice between alternative chemical products in a consumer application)*

Attitude Outcomes

Appreciation of Science

Students will be encouraged to:

- appreciate the role, contributions and limits of science and technology *(e.g., consider more than one perspective when formulating conclusions, solving problems or making decisions on STS issues; show awareness of different perspectives on environmental quality issues)*
- appreciate the diversity of individuals and societal groups that have contributed to science and technology *(e.g., avoid stereotyping scientists)*

Interest in Science

Students will be encouraged to:

- show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., actively participate in extracurricular activities, such as science fairs, science clubs, or science and technology challenges)*

Scientific Inquiry

Students will be encouraged to:

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., consider observations and ideas from a number of sources during investigations and before drawing conclusions; strive to assess a problem or situation accurately, by careful analysis of evidence gathered)*

Collaboration

Students will be encouraged to:

- work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group)*

Stewardship

Students will be encouraged to:

- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., show respect for all forms of life; modify their behaviour in light of an issue related to conservation and protection of the environment; recognize that the materials we use may have environmental consequences when we dispose of them)*

Safety

Students will be encouraged to:

- show concern for safety in planning, carrying out and reviewing activities *(e.g., take the time to organize their work area so that accidents can be prevented; read the labels on materials before using them, and ask for help if safety symbols are not clear or understood; clean their work area during and after an activity; use safety precautions without being reminded)*

Unit D: Electrical Principles and Technologies *(Science and Technology emphasis)*

Overview: Current electricity provides the means to energize many devices, systems and processes that are part of our technological environment. Electricity—in combination with these technologies—is used to transfer energy, to provide mechanisms for control and to transmit information in a variety of forms. In this unit, students learn the principles that underlie electrical technologies by studying the form and function of electrical devices and by investigating ways to transfer, modify, measure, transform and control electrical energy. Using a problem-solving approach, students create and modify circuits to meet a variety of needs. Students develop skills for evaluating technologies by comparing alternate designs and by considering their efficiency, effectiveness and environmental impact.

This unit builds on ideas introduced in Grade 8, Unit D: *Mechanical Systems*, and introduces ideas that will be developed further in Science 10, Unit B: *Energy Flow in Technological Systems*, and in Science 30 Unit C: *Electromagnetic Energy.*

Focussing Questions: How do we obtain and use electrical energy? What scientific principles are involved, and what approaches can we use in selecting, developing and using energy-consuming devices that are efficient and effective in their energy use?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the learning outcomes below.

- ☆ forms of energy
- ☆ energy transformation
- ☆ generation of electrical energy
- ☆ electric charge and current
- ☆ circuits
- ☆ energy storage
- ☆ energy transmission
- ☆ measures and units of electrical energy
- ☆ electrical resistance and Ohm's law
- ☆ renewable and nonrenewable energy

STS and Knowledge Outcomes

Students will:

1. Investigate and interpret the conversion of energy in devices involving electrical, chemical, thermal (heat) and other forms of energy
   - identify, describe and interpret examples of chemical, thermal (heat) and electrical energy
   - investigate and describe evidence of energy transfer and transformation *(e.g., electrical energy transferred through power grids; electrical energy converted to chemical energy in a flashlight; thermal energy converted to electrical energy in a thermocouple)*
   - investigate and evaluate the use of different chemicals, chemical concentrations and designs for electrical storage cells *(e.g. build and test different forms of wet cells)*
   - construct, use and evaluate devices for transforming mechanical energy into electrical energy and for transforming electrical energy into mechanical energy
   - modify the design of an electrical device, and observe and evaluate resulting changes *(e.g., investigate the effect of changes in the orientation and placement of magnets, commutator and armature in a St. Louis motor, or in a personally-built model of a motor)*

2. Describe technologies for transfer and control of electrical energy
   - assess the potential danger of electrical devices by referring to the voltage and amperage of the device, and distinguish between safe and unsafe activities
   - distinguish between static and current electricity and identify example evidence of each

- identify electrical conductors and insulators and compare the resistance of different materials to electric flow *(e.g., compare the resistance of copper wire and nichrome wire; investigate the conduction of electricity through different solutions; investigate applications of electrical resistance in polygraph or "lie detector" tests)*
- use switches and resistors to control electrical flow, and predict the effects of these and other devices in given applications *(e.g., investigate and describe the operation of a rheostat)*
- describe—using models—the nature of electrical current, and explain the relationship between current, resistance and voltage *(e.g., use a hydro-flow model to explain current, resistance and voltage)*
- measure electrical resistance, and predict current flow, using Ohm's law *(e.g., measure the different resistances of copper wire, nichrome wire, pencil leads and salt solution)* **[Prerequisite Skill: Grade 8 Mathematics, Patterns and Relations, SO 5]**
- develop, test and troubleshoot circuit designs for a variety of specific purposes, based on low voltage circuits *(e.g., develop and test a device that is activated by a photoelectric cell; develop a model hoist that will lift a load to a given level, then stop and release its load; test and evaluate the use of series and parallel circuits for wiring a set of lights)*
- investigate toys, models and household appliances, and draw circuit diagrams to show the flow of electricity through them *(e.g., safely dismantle discarded devices such as heating devices or motorized toys and draw diagrams to show the loads, conductors, and switching mechanisms)*
- identify similarities and differences between microelectronic circuits and circuits in a house *(e.g., compare the uses of switches in a house and transistors in a micro-circuit)*

3. Identify and estimate energy inputs and outputs for example devices and systems, and evaluate the efficiency of energy conversions
   - identify the forms of energy inputs and outputs in a device or system
   - apply appropriate units, measures and devices in determining and describing quantities of electrical and heat energy *(e.g., measure, estimate or calculate the quantity of energy transformed by an electrical device)* **[Prerequisite Skill: Grade 8 Mathematics, Patterns and Relations, SO 5]**
   - apply the concepts of conservation of energy and efficiency to the analysis of energy devices *(e.g., identify examples of energy dissipation in the form of heat, and describe the effect of these losses on useful energy output)*
   - compare energy inputs and outputs of a device, and calculate its efficiency *(e.g., given information on electrical consumption and work output of a motor-driven device, compare the number of joules of energy used, with the number of joules of work produced)* **[Prerequisite Skill: Grade 8 Mathematics, Patterns and Relations, SO 14, 15]**
   - investigate and describe techniques for reducing waste of energy in common household devices *(e.g., by eliminating sources of friction in mechanical components, using more efficient forms of lighting; reducing overuse of appliances as in "overdrying" of clothes)*

4. Describe and discuss the societal and environmental implications of the use of electrical energy
   - identify and evaluate alternative sources of electrical energy, including oil, gas, coal, biomass, wind, waves and batteries *(e.g., identify renewable and nonrenewable sources for generating electricity; evaluate the use of batteries as an alternative to internal combustion engines)*
   - describe the by-products of electrical generation and their impacts on the environment *(e.g., identify by-products and potential impacts of coal-fired electricity generation)*
   - identify example uses of electrical technologies, and evaluate technologies in terms of benefits and impacts *(e.g., identify benefits and issues related to the use of electronic technologies for storing and transmitting personal information)*

- identify concerns regarding conservation of energy resources, and evaluate means for improving the sustainability of energy use

Skill Outcomes *(focus on problem solving)*

Initiating and Planning

Students will:

Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- propose alternative solutions to a given practical problem, select one, and develop a plan
- identify questions to investigate arising from practical problems and issues *(e.g., identify questions, such as "How can the amount of electric current in a circuit be controlled?")*
- rephrase questions in a testable form, and clearly define practical problems *(e.g., rephrase questions, such as "Why do we use parallel circuits rather than series circuits in household wiring?" to "How do series circuits and parallel circuits respond differently under load?")*
- state a prediction and a hypothesis based on background information or an observed pattern of events *(e.g., predict the amount of current in a circuit of known resistance and applied voltage)*
- formulate operational definitions of major variables in the study of electrical circuits *(e.g., provide operational definitions for current, resistance, voltage, polarity)*

Performing and Recording

Students will:

Conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data

- use tools and apparatus safely *(e.g., use appropriate sources of electrical energy, and follow procedures to ensure personal and group safety)*
- estimate measurements *(e.g., estimate the efficiency of a mechanical device)*
- use instruments effectively and accurately for collecting data *(e.g., use ammeters and voltmeters)*

Analyzing and Interpreting

Students will:

Analyze qualitative data, and develop and assess possible explanations

- test the design of a constructed device or system
- evaluate designs and prototypes in terms of function, reliability, safety, efficiency, use of materials and impact on the environment *(e.g., evaluate the safety, durability, efficiency and environmental impact of a personally-constructed wet cell design)*
- identify and correct practical problems in the way a prototype or constructed device functions
- identify and suggest explanations for discrepancies in data *(e.g., measure the current in similar circuits, and provide possible explanations for differences in current flow)*
- identify potential sources of error, and determine the amount of error in a given measurement *(e.g., identify the precision of voltmeters and ammeters used to measure current flow)*

Communication and Teamwork

Students will:

Work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results

- work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise

- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., use graphs to present data on the voltage, current and resistance found in series and parallel circuits)*
- defend a given position on an issue or problem based on their findings *(e.g., develop and defend a proposal on the appropriateness of an alternative energy source in a given application)*

Attitude Outcomes

Appreciation of Science

Students will be encouraged to:

- appreciate the role, contributions and limits of science and technology *(e.g., recognize the usefulness of mathematical and problem-solving skills in the development of a new technology; identify advantages and disadvantages of a technology)*

Interest in Science

Students will be encouraged to:

- show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., actively participate in extracurricular activities, such as science fairs or science and technology challenges; pursue a science or technology-related hobby; choose to investigate topics related to electrical technologies)*

Scientific Inquiry

Students will be encouraged to:

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., strive to assess a problem or situation accurately, by careful analysis of evidence gathered; ask questions to clarify meaning or confirm their understanding; report the limitations of their designs; continue working on a problem or research project until the best possible solutions or answers are uncovered)*

Collaboration

Students will be encouraged to:

- work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., demonstrate interest and become involved in decision making that requires full-group participation; consider alternative ideas and interpretations suggested by members of the group; share the responsibility for difficulties encountered in an activity)*

Stewardship

Students will be encouraged to:

- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., objectively identify potential conflicts between responding to human wants and needs and safety concerns)*

Safety

Students will be encouraged to:

- show concern for safety in planning, carrying out and reviewing activities *(e.g., select safe methods in using electrical devices; readily alter a procedure to ensure the safety of members of the group; stay at their own work area during an activity, respecting others' space, materials and work)*

Unit E: Space Exploration *(Science and Technology emphasis)*

Overview: Technologies have played an essential role in the study of space and in the emerging use of space environments. Our modern understanding of space has developed in conjunction with advances in techniques for viewing distant objects, for transmitting images and data through space, and for manned and unmanned space exploration. A study of space exploration provides opportunity for students to examine how science and technology interact and learn how one process augments the other. Through this study, students become aware of problems that have been addressed through these enterprises, and examine a variety of approaches to problem identification and solution. Students also become aware of the application of space technologies to new purposes and consider implications for the future.

This unit builds on ideas introduced in Grade 6, Unit C: *Sky Science*, and introduces ideas that will be developed further in Science 30, Unit C: *Electromagnetic Energy.*

Focussing Questions: How have humans attained a presence in space? What technologies have been developed, based on what scientific ideas? How has the development of these technologies contributed to the exploration, use and understanding of space and to benefits on Earth?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the learning outcomes below.

- ☆ Technologies for space exploration and observation
- ☆ reference frames for describing position and motion in space
- ☆ satellites and orbits
- ☆ distribution of matter through space
- ☆ composition and characteristics of bodies in space
- ☆ life support technologies
- ☆ communication technologies

STS and Knowledge Outcomes

Students will:

1. Investigate and describe ways that human understanding of Earth and space has depended on technological development
   - identify different perspectives on the nature of Earth and space, based on culture and science *(e.g., describe cosmologies based on an Earth-centred universe; describe aboriginal views of space and those of other cultures; describe the role of observation in guiding scientific understanding)*
   - investigate and illustrate the contributions of technological advances—including optical telescopes, spectral analysis and space travel—to a scientific understanding of space
   - describe, in general terms, the distribution of matter in space *(e.g., stars, star systems, galaxies, nebulae)*
   - identify evidence for—and describe characteristics of—bodies that make up the solar system, and compare their characteristics with those of Earth
   - describe and apply techniques for determining the position and motion of objects in space
     - construct and interpret drawings and physical models that illustrate the motion to objects in space *(e.g., represent the orbit of comets around the Sun, using a looped string model)*
     - describe techniques used to estimate distances of objects in space and to determine their motions

- describe the position of objects in space, using angular coordinates *(e.g., describe the location of a spot on a wall by identifying its angle of elevation and its bearing or azimuth [degrees east of north] from two locations in a room)* **[Prerequisite Skill: Grade 6 Mathematics, Shape and Space, SO 10]**

- investigate predictions about the motions, alignments, and collision of bodies in space; and critically examine the evidence on which they are based *(e.g., investigate predictions of eclipses, identify uncertainties in predicting and tracking meteor showers)*

2. Identify problems in developing technologies for space explorations, describe technologies developed for life in space, and explain the scientific principles involved
   - analyze space environments, and identify challenges that must be met in developing life supporting systems *(e.g., analyze implications of variations in gravity, temperature, availability of water, atmospheric pressure and atmospheric composition)*
   - describe technologies for life-support systems, and interpret the scientific principles on which they are based *(e.g., investigate systems that involve recycling of water and air)*
   - describe technologies for space transport, and interpret scientific principles involved *(e.g., describe the development of multistage rockets, shuttles and space stations; build a model vehicle to explore a planet or moon)*
   - identify materials and processes developed to meet needs in space and their applications to non-space uses *(e.g., medicines, remote sensing, microelectronics, polymers, medical imaging, wireless communication technologies, synthesis of fuels in space)*
   - describe the development of artificial satellites, and explain major purposes for which they are used *(e.g. communication, GPS [global positioning system]; weather observation)*

3. Describe and interpret the science of optical and radio telescopes space probes and remote sensing technologies
   - explain, in general terms, the operation of optical telescopes, including telescopes that are positioned in space environments
   - explain the role of radio and optical telescopes in determining characteristics of stars and star systems
   - describe and interpret, in general terms, the technologies used in global positioning systems and in remote sensing *(e.g., use triangulation to determine the position of an object, given information on the distance from three different points. Note this example involves use of geometric approaches rather than mathematical calculations.)*

4. Identify issues and opportunities arising from the application of space technology, identify alternatives involved, and analyze their implications
   - recognize risks and dangers associated with space exploration *(e.g., space junk, fuel expenditure, satellites burning up in the atmosphere; solar radiation)*
   - describe Canadian contributions to space research and development and to the astronaut program *(e.g., Canadarm)*
   - identify and analyze factors that are important to decisions regarding space exploration and development *(e.g., identify examples costs and potential benefits that may be considered; investigate and describe examples of the political, environmental and ethical issues related to ownership and use of resources in space)*

Skill Outcomes *(focus on problem solving)*

Initiating and Planning

Students will:

Ask questions about relationships between and among observable variables, and plan investigations to address those questions

- identify practical problems *(e.g., identify problems that must be addressed in developing a life-supporting space environment)*
- propose alternative solutions to a given practical problem, select one, and develop a plan *(e.g., design and describe a model of a technology to be used in a space station)*
- state a prediction and a hypothesis based on background information or an observed pattern of events *(e.g., predict the next appearance of a comet, based on past observations; develop a hypothesis about the geologic history of a planet or its moon, based on recent data)*

Performing and Recording

Students will:

Conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data

- research information relevant to a given problem
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., compile and compare information about two exploratory missions)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., maintain a log of observed changes in the night sky; prepare a data table to compare various planets)*

Analyzing and Interpreting

Students will:

Analyze qualitative data, and develop and assess possible explanations

- test the design of a constructed device or system *(e.g., create and test a model device for remote manipulation of materials)*
- identify and correct practical problems in the way a prototype or constructed device functions *(e.g., identify and correct problems in the functioning of a model "remote transportation device" that they have designed and built)*
- identify the strengths and weaknesses of different methods of collecting and displaying data *(e.g., compare Earth-based observations to those made from spacecraft)*
- identify new questions and problems that arise from what was learned *(e.g., identify questions to guide further investigation, such as: "What limits the travelling distance and duration of space exploration?", "How old are the planets, and how did they form?")*

Communication and Teamwork

Students will:

Work collaboratively on problems, and use appropriate language and formats to communicate ideas, procedures and results

- receive, understand and act on the ideas of others *(e.g., take into account advice provided by other students or individuals in designing a model space suit or space vehicle)*
- work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise *(e.g., write and act out a skit to demonstrate tasks carried out by astronauts on a mission)*

- defend a given position on an issue or problem, based on their findings *(e.g., conduct appropriate research to justify their position on the economic costs or benefits of space exploration)*

Attitude Outcomes

Appreciation of Science

Students will be encouraged to:

- appreciate the role, contributions and limits of science and technology *(e.g., appreciate the contributions of technology to human welfare; appreciate the role of technology in advancing our understanding of space environments; recognize that science and technology cannot answer all questions)*
- appreciate the diversity of individuals and societal groups that have contributed to science and technology *(e.g., show an interest in the contributions that women and men from many cultural backgrounds have made to the development of modern science)*

Interest in Science

Students will be encouraged to:

- show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., express interest and describe media programs on space science and technology; take an interest in directly observing and interpreting space environments and in personal and group excursions to a space science centre)*

Scientific Inquiry

Students will be encouraged to:

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., seek accurate data that is based on appropriate methods of investigation; consider observations and ideas from a number of sources before drawing conclusions)*

Collaboration

Students will be encouraged to:

- work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., work with others to identify problems and explore possible solutions; share observations and ideas with other members of a group, and consider alternative ideas suggested by other group members; share the responsibility for carrying out decisions)*

Stewardship

Students will be encouraged to:

- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., consider immediate and long-term consequences of personal and group actions; objectively identify potential conflicts between responding to human wants and needs and protecting the environment)*

Safety

Students will be encouraged to:

- show concern for safety in planning, carrying out and reviewing activities *(e.g., select safe methods and tools for collecting evidence and solving problems; readily alter a procedure to ensure the safety of members of the group)*